RTCA Special Committee 186, Working Group 5

ADS-B UAT MOPS (DO-282), Revision A

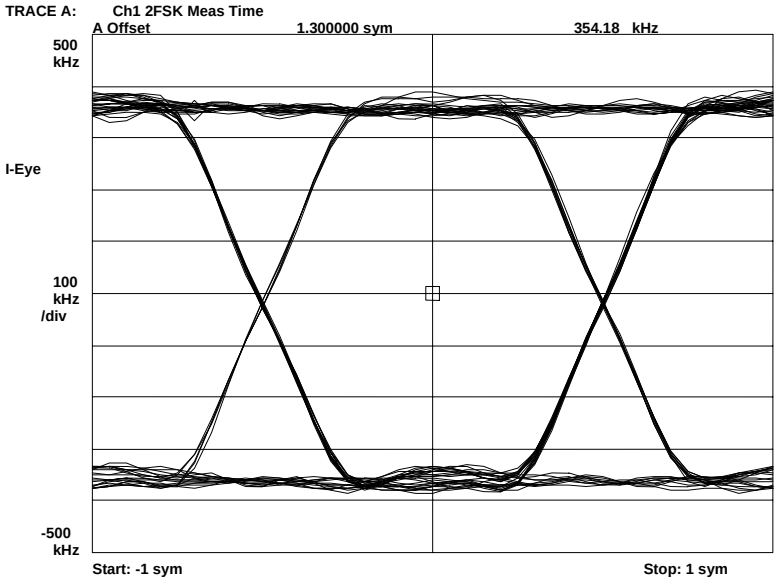
Meeting #15

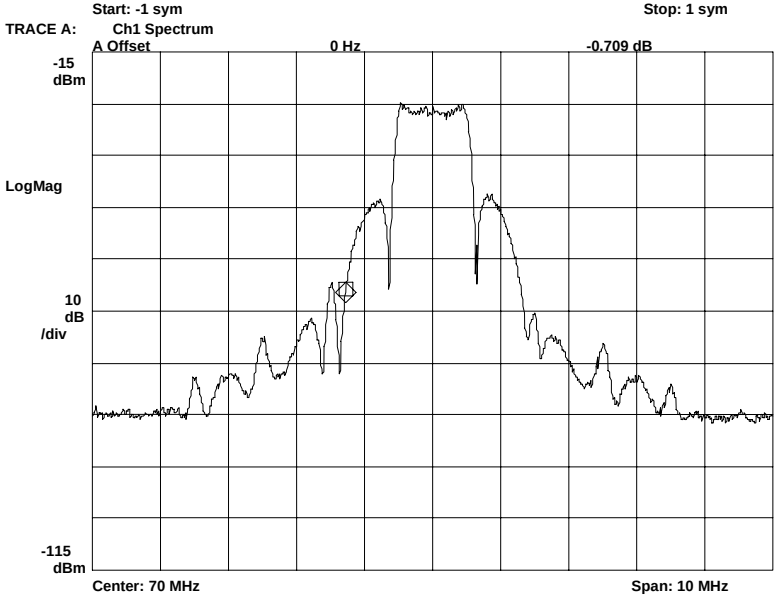
Additional Thoughts on the Eye Diagram

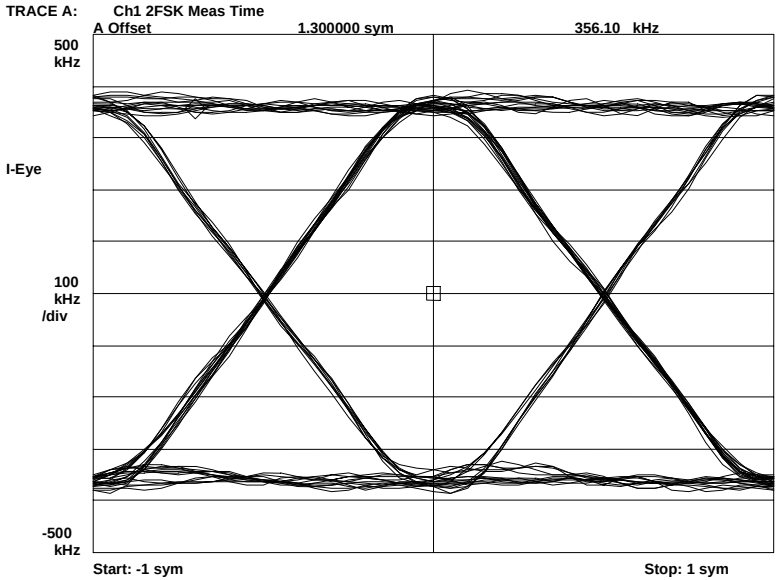
Presented by Ed Valovage

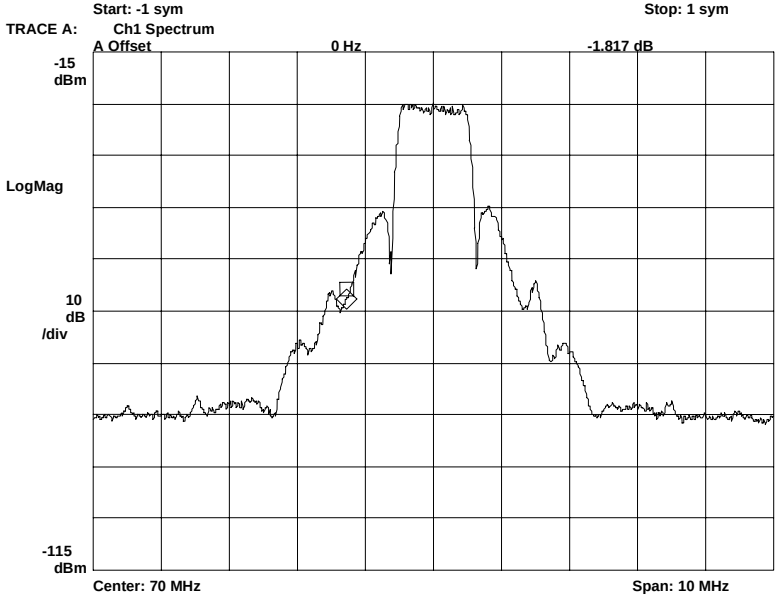
SUMMARY

Earlier concern was raised by me (with agreement from some others) about the use of a root raised cosine filter in the measurement of the eye diagram. After further consideration I am satisfied that it is a reasonable way to make the measurement. These pictures illustrate a rationale for the use of root raised cosine filter.

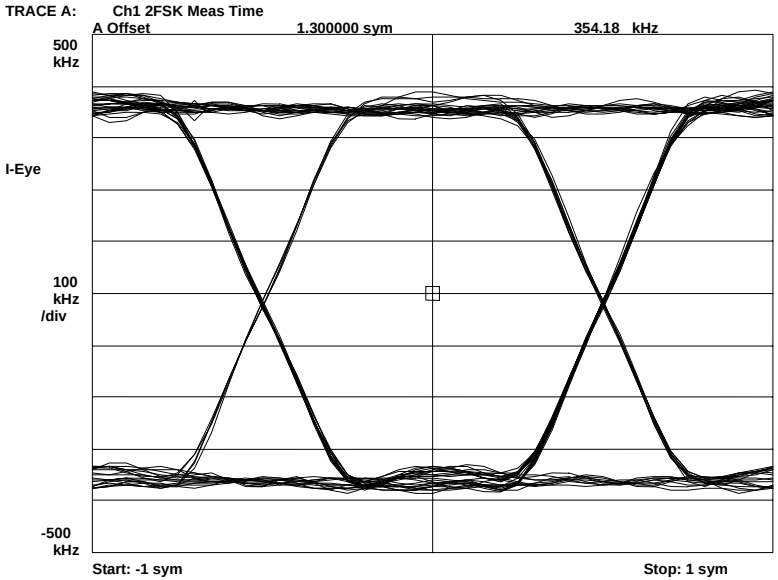


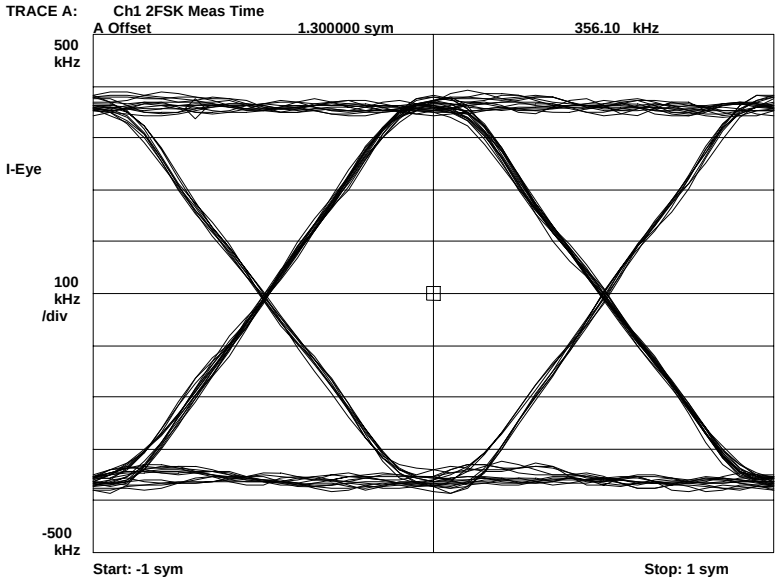


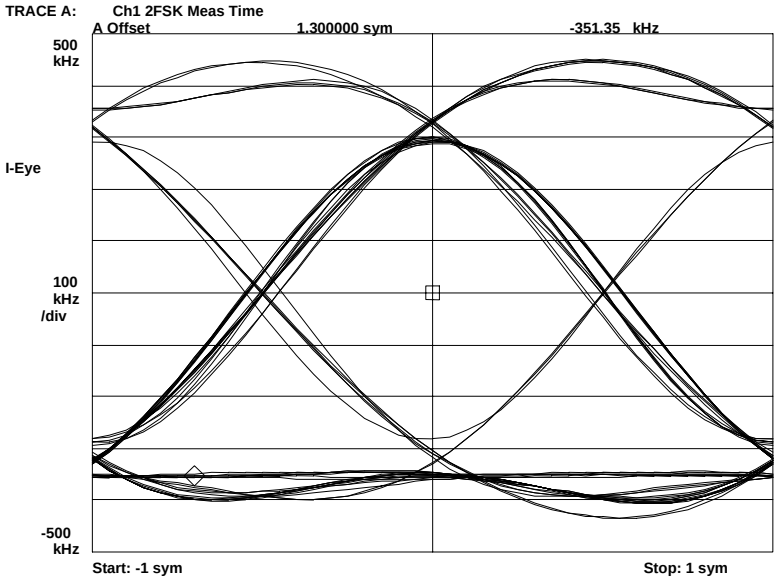


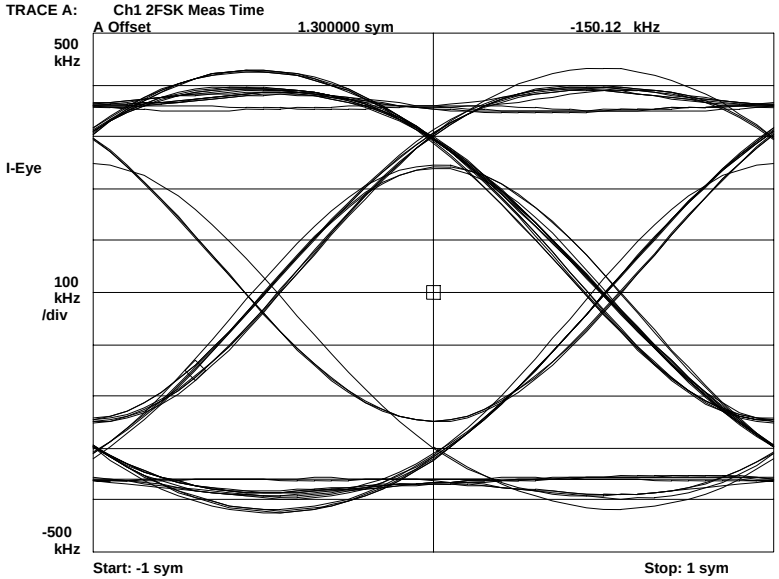


Here are two ramped FSK waveforms. (The lower ramp slope has a better spectrum.) The eye diagrams are plotted with no filtering, i.e. full spectrum (7 MHz). They have the same deviation but different shapes.

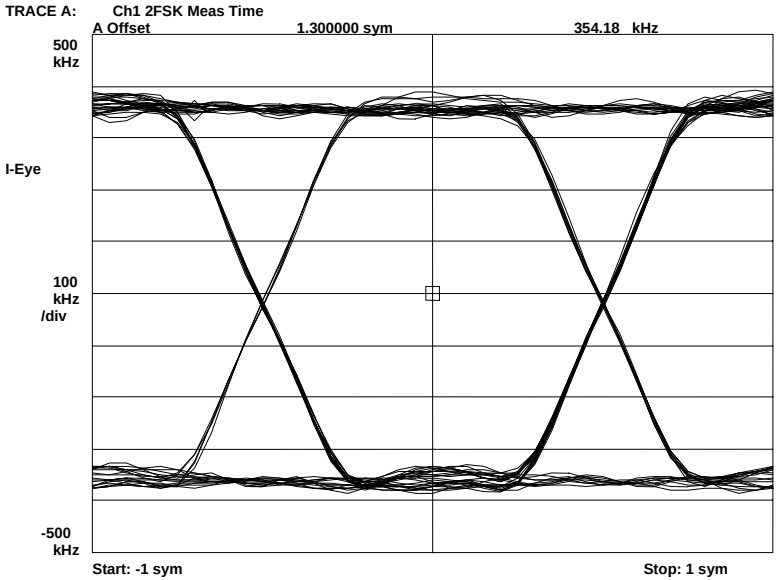


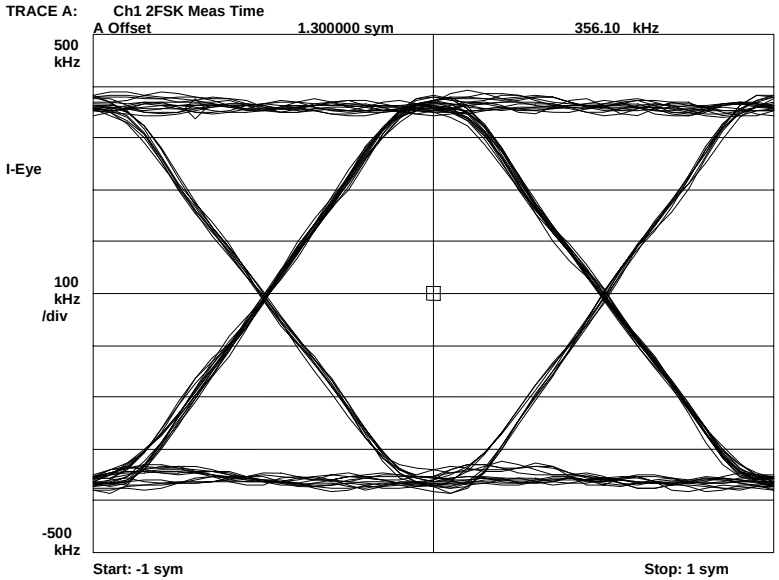


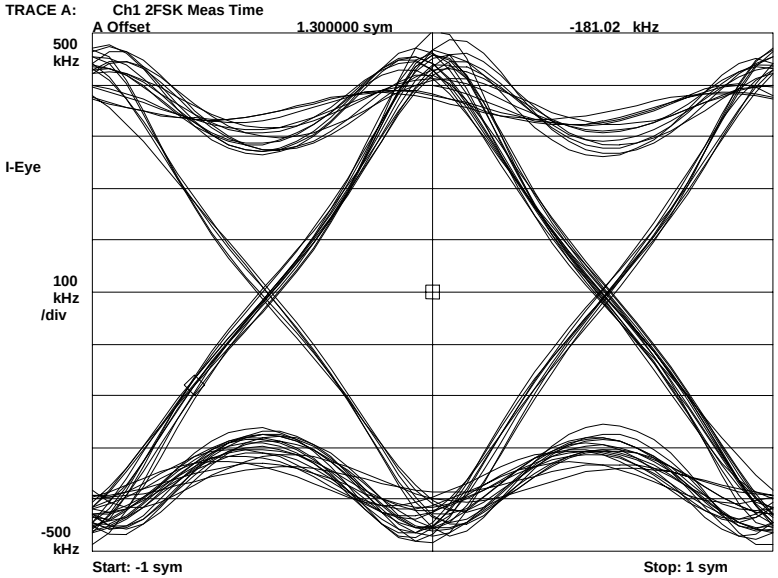


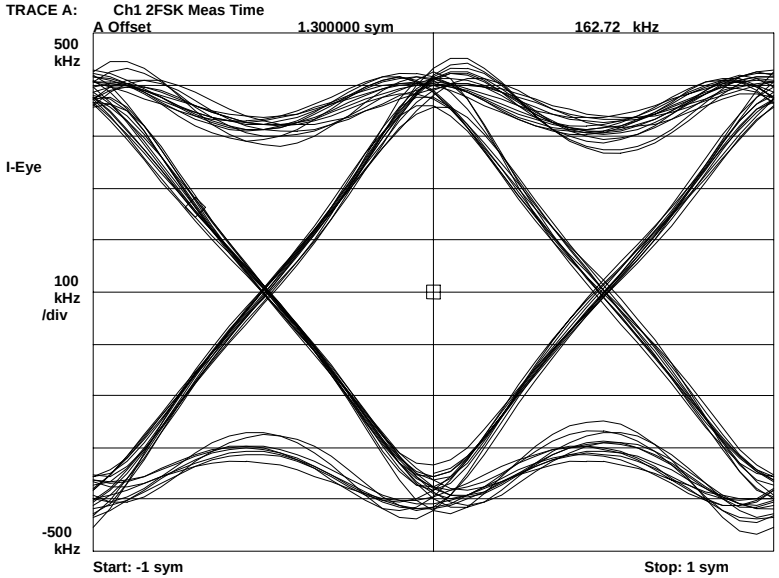


Here are the same two waveforms. The lower eye diagrams are plotted with root raised cosine filters. With this limited bandwidth, there is a deviation difference.









Here are the eye diagrams with and no root raised cosine filter but with analyzer bandwidth of 1.2 MHz (i.e. a different filter). The deviation difference is still seen.

Since any useful receiver/demodulator will have some kind of limited bandwidth (for good performance at low SNR), the shape of the frequency deviation makes a difference in the ability to demodulate it. We must make some kind of restriction to this shape. Since there are so many degrees of freedom on the shape, the requirement has to translate to one or two parameters. One way to do this is to filter the eye diagram. One choice of filter is the root raised cosine filter, which is the receiver half of the optimum transmit/receiver pair.

Conclusion: The method of measuring the eye diagram is no longer in question for the reason I had previoulsy posed.